

WHAT IS CLAIMED IS:

1. A method of forming a VCSEL having a plurality of layers, comprising:

forming an ohmic contact adjacent an optical cavity;

5 forming a mesa in at least a portion of said plurality of VCSEL layers in accordance with said ohmic contact to expose an oxide aperture layer; and

10 oxidizing said oxide aperture layer to form an oxide aperture that is aligned with ohmic aperture formed by said ohmic contact.

2. The method of claim 1 further comprising forming a photoresist layer adjacent said ohmic aperture and a portion of said ohmic contact and wherein forming a mesa in 15 at least a portion of said plurality of VCSEL layers comprises etching at least a portion of said plurality of VCSEL layers using exposed portion of said ohmic contact as an etch mask to define mesa sidewalls.

20 3. The method of claim 1 further comprising forming an upper mirror adjacent said ohmic contact and said optical cavity.

25 4. The method of claim 1 wherein said optical cavity comprises an active region comprising one or more active layers.

30 5. The method of claim 4 wherein said optical cavity further comprises a delta doped upper cladding and wherein said ohmic contact is formed adjacent said delta doped upper cladding to reduce contact resistance of said ohmic contact.

6. The method of claim 1 further comprising forming a dielectric spacer layer adjacent said optical cavity.

7. The method of claim 6 further comprising forming 5 a multi-step photoresist adjacent said dielectric spacer layer and patterning said multi-step photoresist to define a via in said dielectric spacer layer for formation of said ohmic contact adjacent said optical cavity.

10 8. A method of forming a VCSEL having a plurality of layers, comprising:

forming a lower mirror on a substrate;
forming an optical cavity over said lower mirror;
forming an oxide aperture layer over said optical 15 cavity;
forming a p-type contact layer over said oxide aperture layer;
forming an annular ohmic contact pad on said p-type contact layer;
20 removing a plurality of layers of said VCSEL around said ohmic contact pad using an outer circumferential edge of said ohmic contact pad as a mask to form a circular mesa and thereby expose said oxide aperture layer at the mesa sidewall; and
25 oxidizing said oxide aperture layer inwardly from said mesa sidewall to form an annular oxide aperture that is self-aligned with said ohmic contact.

9. The method of claim 8 further comprising the step of forming an upper mirror structure over at least an inner portion of said ohmic contact to form a completed VCSEL structure.

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10. A method of forming a VCSEL having a plurality of layers, comprising:

forming a lower mirror on a substrate;

forming an optical cavity over said lower mirror;

10 forming an oxide aperture layer over said optical cavity;

forming a p-type contact layer over said oxide aperture layer;

15 forming a dielectric rephase layer over said p-type contact layer;

depositing a photoresist over said dielectric rephase layer;

20 patterning said photoresist to provide a circular puck of rephase material within said rephase layer and simultaneously define an annular via in said dielectric spacer layer;

25 forming an annular ohmic contact pad within said via, said ohmic contact pad being self-aligned with said puck of rephase material as a result of said patterning step;

removing said photoresist and said rephase layer outside said ohmic contact pad;

30 removing a plurality of layers of said VCSEL around said ohmic contact pad using an outer circumferential edge of said ohmic contact pad as a mask to form a circular mesa and thereby expose said oxide aperture layer at the mesa sidewall; and

oxidizing said oxide aperture layer inwardly from said mesa sidewall to form an annular oxide aperture that is self-aligned with said ohmic contact.

5 11. The method of claim 8 further comprising the step of forming an upper mirror structure over at least an inner portion of said ohmic contact to form a completed VCSEL structure.

10 12. A method of forming a VCSEL having a plurality of layers, comprising:

forming a lower mirror on a substrate;
forming an n-type contact layer over said lower mirror;

15 forming an optical cavity over said lower mirror;
forming an oxide aperture layer over said optical cavity;

forming a p-type contact layer over said oxide aperture layer;

20 forming an annular ohmic contact pad on said p-type contact layer;

removing a plurality of layers of said VCSEL around said ohmic contact pad using an outer circumferential edge of said ohmic contact pad as a mask to form a circular mesa and to thereby expose said oxide aperture layer at the mesa sidewall, and to thereby further expose an upper surface of said n-type contact layer;

25 oxidizing said oxide aperture layer inwardly from said mesa sidewall to form an annular oxide aperture that is self-aligned with said ohmic contact; and

30 forming an ohmic contact pad on said exposed surface of said n-type contact layer.

13. The method of claim 12 further comprising the
step of forming an upper mirror structure over at least an
inner portion of said p-type ohmic contact to form a
5 completed VCSEL structure.

14. The method of claim 12 wherein said lower mirror
is an undoped mirror structure.

10 15. A method of forming a VCSEL having a plurality of
layers, comprising:

forming a lower mirror on a substrate;
forming an n-type contact layer over said lower
mirror;

15 forming an optical cavity over said lower mirror;
forming an oxide aperture layer over said optical
cavity;

forming a p-type contact layer over said oxide
aperture layer;

20 forming a dielectric rephase layer over said p-type
contact layer;

depositing a photoresist over said dielectric rephase
layer;

25 patterning said photoresist to provide a circular puck
of rephase material within said rephase layer and
simultaneously define an annular via in said dielectric
spacer layer;

30 forming an annular ohmic contact pad within said via,
said ohmic contact pad being self-aligned with said puck of
rephase material as a result of said patterning step;

removing said photoresist and said rephase layer
outside said ohmic contact pad;

removing a plurality of layers of said VCSEL around
said ohmic contact pad using an outer circumferential edge
of said ohmic contact pad as a mask to form a circular mesa
and to thereby expose said oxide aperture layer at the mesa
5 sidewall, and to thereby further expose an upper surface of
said n-type contact layer;

oxidizing said oxide aperture layer inwardly from said
mesa sidewall to form an annular oxide aperture that is
self-aligned with said ohmic contact; and

10 forming an ohmic contact pad on said exposed surface
of said n-type contact layer.

16. The method of claim 15 further comprising the
step of forming an upper mirror structure over at least an
15 inner portion of said p-type ohmic contact to form a
completed VCSEL structure.

17. The method of claim 15 wherein said lower mirror
is an undoped mirror structure.

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